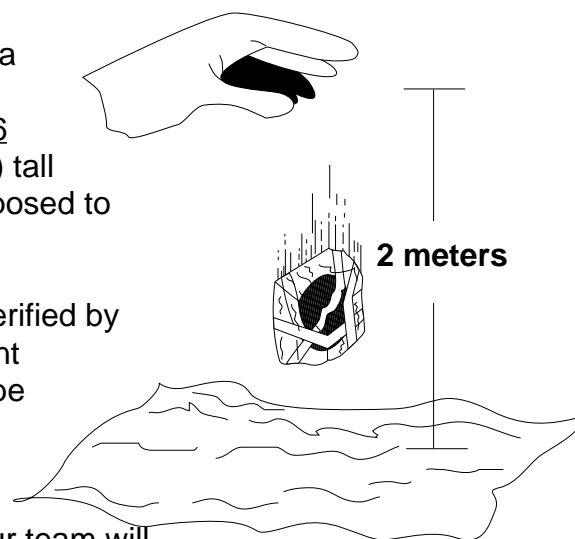


DESIGNING FOR SAFETY

During the past 40 years, nuclear materials, including nuclear waste, have been transported safely. Scientists and engineers work together to design and build casks that will ensure the safety of workers, the public, and the environment during the transportation of nuclear waste. Casks used to transport spent fuel rods are designed and constructed to contain radioactivity under normal travel conditions and in situations that may result in the event of a rail or highway accident.

In tests conducted to certify the safety of casks, the most vulnerable point of a cask must withstand an impact with a flat unyielding surface after a 9-meter (30-foot) drop, and must withstand hitting a steel rod that is 15 centimeters (6 inches) in diameter and at least 20 centimeters (8 inches) tall after a 1-meter (40-inch) drop. The entire cask is also exposed to a 800 °C (1,475 °F) fire for 30 minutes.



The realistic applicability of these test results has been verified by full-sized, scale, and computer modeling of actual accident situations. In each case, damage to the casks proved to be superficial, and the cargo remained isolated from the environment.

To help you understand designing for safety, you and your team will design and build a "cask" for the protection of a raw egg. Under the supervision of your instructor, you will test your cask by dropping it from a height of 2 meters (6.6 feet) onto a plastic sheet.

Purpose:

What is the purpose of this activity?

(The purpose of this activity is to model the development and engineering of transportation casks for spent fuel assemblies.)

Materials:

Each Group

1 raw egg
2 sheets of 8 1/2" x 11" paper
1 meter of tape

Whole Class

plastic sheet
meter stick

Procedures:

1. As a group, discuss and agree upon a design for your "cask" that will protect your egg from all angles during the test drop. Draw your cask in the observation section.
2. Construct your cask. You do not need to use all of the materials provided, but you may not use any additional materials.
3. Decide as a group the most vulnerable point of your cask. Mark this spot to identify it.
4. When all teams have completed building their casks, one member of your team will drop your cask in the testing area on its most vulnerable spot from a height of 2 meters (6.6 feet).
5. Eggs that survive the 2-meter (6.6 feet) drop will have travelled in safe casks. Take time to observe the strengths of the casks in your class that survived the drop.

Observations:

Draw the design for your cask below. Label the point you have chosen as the most vulnerable.

1. Did your egg survive the fall? Why or why not?

(Answers will vary.)

2. List the qualities you have observed of the casks that survived the drop.

(Answers will vary. Encourage students to think carefully.)

Conclusion:

1. If you were forced to make improvements on your cask whether it survived the drop or not, what changes would you make? (Assume the same supply of materials.)

(Answers will vary. Encourage students to be as detailed as possible.)

2. What factors do engineers need to consider when designing a cask to transport spent fuel?

(Engineers need to consider the most extreme conditions of temperature and pressure.

They must also design tests to prove the capabilities of their cask design.)
